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THE DURATION OF THE HUNGARIAN MAIZE EXPORTS

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Abstract

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The maize is one of the most important agricultural export products in Hungary. The paper investigates the duration of Hungarian maize exports over the period 1996-2015. We employ different discrete time models to explain the drivers of Hungarian maize exports at the world market. Calculations show that Hungarian maize exports are rather short-lived. Our results suggest that standard gravity model variables like market size, level of economic development and distance have significant impacts on the duration of Hungarian maize exports. In addition, whilst the EU membership decrease, the economic crisis rather increase the probability of exports failures Hungarian maize exports.

Key words: agriculture; maize export; Hungary; duration model; food crisis

Introduction

There is increasing literature on the impacts of global food crisis on the commodity markets (e.g. Akhter, 2017; Gutierezz, 2012; Tadassee et al., 2016). While majority of papers concentrate on the various impact of price spikes on commodity markets, poverty in developing countries there is less attention on the effects of crisis on agri-food trade (e.g. Heady, 2011; Giordani et al., 2016). Although the importance of trade events in rice and wheat markets is widely analysed, there has been virtually no discussion of trade events being an important factor in world maize markets. This neglection is partly understandable in light of some important features at the global maize market (Heady, 2011). First, the United States strongly dominates the global maize trade, accounting for around 60 percent of world exports, consequently trade restrictions elsewhere have less important to influence international price. Second, maize is also used as livestock feed in much of the world (comparing to rice and wheat which are tipically staple foods) thus the demand for maize is relatively elastic; implying less sensitivity to trade shocks. Third, earlies studies confirm that rising oil prices added considerably to maize production and transportation costs (Headey and Fan, 2008; Mitchell, 2008). Finally, the growing use of maize to biofuels indicating large impact on the global maize market, that trade-based explanations of rising maize prices would seem less attractive.

However, despite of characteristics of global maize market there some bases to justify the importance of trade analysis in this market. The world maize trade is traditionally subject for the trade intervention. The number of major players on the global market is restricted. On the export side, the exporter countries apply different promotion programs, while importer countries use wide range of trade barriers in order to protect their domestic markets. These trading policies are playing important role in determining flows of maize (Koo-Karemera, 1991). Despite of the importance of maize in the global agriculture, the research on maize trade is fairly limited. There are some studies focusing on the international grain trade with special emphasis on the global players (e.g. Jayasinghe et al., 2010; Haq et al., 2013) but papers on the export small maize exporting countries is basically non-existent.

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However, one question is not yet addressed in empirical agri-food trade literature: when do countries trade and how long do their trade relationships last? Our analysis of this latter issue is, among other things, motivated by the finding of recent research that many countries do not trade in any given year and for any given product (Haveman and Hummels, 2004; Feenstra and Rose, 2000; Schott, 2004). As a consequence of it, a new literature focusing on the duration of international trade has emerged. Based on the surprising finding in Besedeš and Prusa (2006a) that US import flows have a remarkably short duration, the question asked is: "which factors determine how long international trade relationships last?" From a policy-oriented point of view this is indeed an important question to ask. Trade will not grow very much if new products stop being exported after only a few years. Therefore, to better understand which factors may help countries increase their trade, and thereby potentially improve economic development, it is important to learn more about what determines the duration of trade flows. Recent studies provide evidence that trade relationships (e.g. Besedeš and Prusa., 2006b; Nitsch, 2009; Fertő and Soós, 2009; Brenton et al., 2010; Obashi, 2010; Cadot et al., 2013) are surprisingly short lived. Empirical studies usually confirm that exporter characteristics (such as GDP and language), product characteristics (such as unit values) and market characteristics (such as the import value, and market share) affect the duration of trade (Hess and Persson, 2011; 2012). However all studies focus only manufacturing or all products except (Bojnec and Fertő, 2012).

This paper tries to fill this gap. Although Hungary is a small maize exporter country, it was 8th top maize exporter country in 2016. Thus we can argue that Hungary is a good case study to investigate the duration of exports for a small but still an important player in the global maize exports. In addition, recent food crisis provide an additional motivation for our research. The aim of the paper is to analyze the impacts of trade costs and food crises in Hungarian maize export in the last two decades. The structure of paper is following. First, we provide a brief overview on Hungarian maize exports. Next section decribes empiricial methodology following by presentation of results. Final section concludes.

The Hungarian Maize Exports

The Hungarian maize export fluctuated considerably between 1996 and 2015. The level of the Hungarian maize export has been rather low in the first decade of analysed period (Figure 1). However, in the second decade the maize export more than doubled in average. At the same time there were no significant change in the sown area and the averaged harvested volume of maize. The impact of food crisis is visible, despite of poor harvest the value of export dramatically increased. The value export has declined in 2008 and 2009 and its level has recovered only in 2011. Last three years value of exports has fallen below to the crisis years' level.

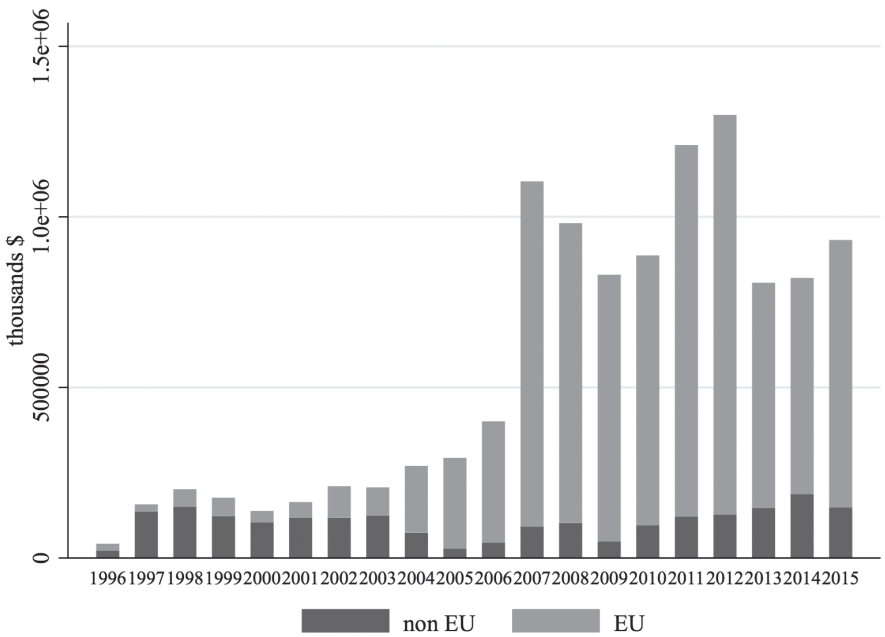

Fig. 1. Hungarian maize exports by main market segments, 1996-2015
Source: The authors' calculations based on World Bank, 2017a

The most important destinations for Hungarian maize exports are Italy, Romania, Netherlands, Germany and Austria (Figure 2). Italy is traditionally one of the most important markets for the Hungarian grain products including maize. Romania is also playing an important role, as it is mostly functioning as a transit country and an exit point to the Black Sea market for the Hungarian maize thanks to the river Danube which is crossing both countries. The value of the average export of the next three countries of Figure 2 shows the importance of their processing sector for the Hungarian maize export and also the importance of the Rhine-Main-Danube Canal which is the only waterway passing the continent and making inland navigation and water transportation possible. Two large non-EU markets are still playing relatively important role: Russian and the Ukraine.

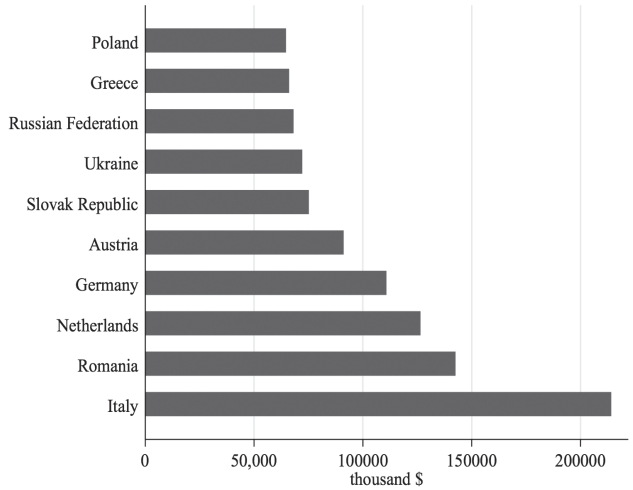

Fig. 2. The average exports of top 10 Hungarian destinations between 1996 and 2015
Source: The authors' calculations based on World Bank, 2017a

Hungary has exported maize to 83 countries during the analysed period. However, the number of destinations is much lower per year. The number of trading partners is varying between 27 and 47 (Figure 3). Interestingly, the first decade the geographical concentration of maize export has been much lower with smaller export value. The geographical concentration has increased with higher number of trading partners and higher export value in the second half of the period. However, the instability in numbers of market partners partly indicate that the source of maize export growth are based on mainly on increase of exports in traditional markets and less than to find new destinations for Hungarian maize.

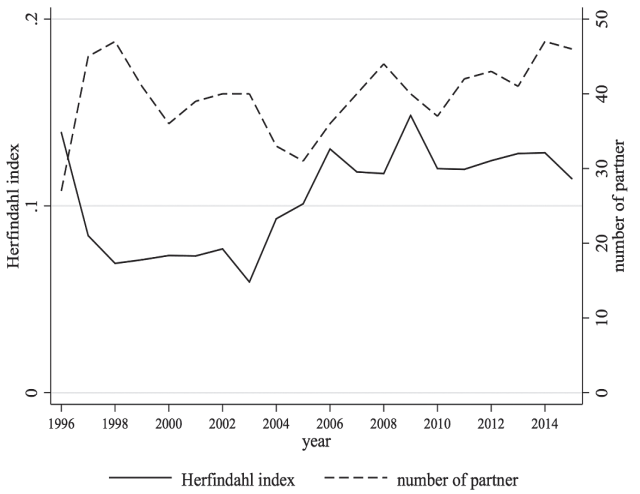

Fig. 3. Market concentration and number of export relationships in Hungarian maize exports
Source: The authors' calculations based on World Bank, 2017a

Material and Methods

There are two empirical strands in the international trade literature on the duration of trade. The first analyses the duration of bilateral trade relations at the product (category) level and the second analyses the trade behaviour of firms, in particular switching of export products and destinations. This paper builds upon on the first strand of the literature focusing on country-product relations.

Besedeš and Prusa (2006a) distinguish homogeneous and differentiated goods using the Rauch (1999) classification. They find that homogeneous goods have higher hazard rates than differentiated goods and higher initial trade values increase survival. In addition their results indicate lower transportation costs, higher GDP, higher tariffs, and depreciation of the source country's currency all lead to longer durations. Nitsch (2009) applies also Cox proportional hazard models on the duration of German import relations between 1995 and 2005. He also concludes that GDP in the exporting country and a similar language lowers the hazard rate. This is also the case for the initial trade value and market share in the importing country. Brenton et al. (2009) analyse the duration of export flows at the 5-digit SITC level of about 80 exporting countries and 50 importing countries between 1985 and 2005. They also conclude that the initial trade value is important for survival. Hess and Persson (2011) focus on the imports of 15 EU-countries from 140 different exporting countries between 1962 and 2006 at the 4-digit SITC level. They conclude that the mean duration of import flows is only 1 year. Morover they show that export diversification,

which – both in terms of the number of products exported and the number of markets served with the given product – substantially lowers the hazard of trade flows dying. Notice that these studies suffer from the lack of theoretical background. Existing theories based on heterogenous firms does not explain the short lived export relationships (Hess and Persson 2011). More recently Besedeš et al (2016) provide a theory to explain some empirical regularity of short lived trade relationships.

We focus on the duration of Hungarian maize exports. Duration analysis of export (export > 0) is estimated by the survival function, S(t), using the nonparametric Kaplan-Meier product limit estimator (Cleves *et al*., 2004). We assume that a sample contains n independent observations denoted (t_i; c_i), where i = 1, 2,…, n, t_i is the survival time, and c_i is the censoring indicator variable C taking a value of 1 if failure occurred, and 0 otherwise of observation i. It is assumed that there are m < n recorded times of failure. The rank-ordered survival times are denoted as $t_{(1)} < t_{(2)} < \ldots < t_{(m)}$, while n_j denotes the number of subjects at risk of failing at $t_{(j)}$, and d_j denotes the number of observed failures. The Kaplan-Meier estimator of the survival function is then:

$$\hat{S}(t) = \prod_{t(i)<t} \frac{n_j - d_j}{n_j}. \quad (1)$$

With the convention that $\hat{S}(t) = 1$ if $t < t_{(1)}$. Given that many observations are censored, it is then noted that the Kaplan-Meier estimator is robust to censoring and uses information from both censored and non-censored observations.

Beyond to descriptive analysis of duration of export, we are interested in the factors explaining the survival. The literature on the determinants of trade and comparative advantage duration uses Cox proportional hazards models (e.g., Besedeš and Prusa, 2006; Bojnec and Fertő, 2012; Cadot et al., 2013). However, recent papers point out three relevant problems inherent in the Cox model that reduce the efficiency of estimators (Hess and Persson, 2011, 2012). First, continuous-time models (such as the Cox model) may result in biased coefficients when the database refers to discrete-time intervals (years in our case) and especially in samples with a high number of ties (numerous short spell lengths). Second, Cox models do not control for unobserved heterogeneity (or frailty). Thus, results might not only be biased, but also spurious. The third issue is based on the proportional hazards assumption that implies similar effects at different moments of the duration spell. Following Hess and Persson (2011), we estimate different discrete-time models, probit, logit and complementary logit specifications, where importer country random effects are incorporated to control for unobservable heterogeneity.

More specifically, we estimate the hazard of exports ceasing at time t by estimating a discrete time hazard model using following specification:

$$\begin{aligned} XD_{ikt} = {} & \alpha_0 + \alpha_1 POP_{it} + \alpha_2 POP_{kt} + \alpha_3 GDPCAP_{it} + \\ & + \alpha_4 GDPCAP_{kt} + \alpha_5 lndistance_{ik} + \alpha_6 RTA_{ikt} + \\ & + \alpha_7 WTO_{ikt} + \alpha_8 EU_{ikt} + \alpha_9 Crisis_{ikt} + \varepsilon_{ikt} \end{aligned} \quad (2)$$

In this paper we investigate determinants of the duration of Hungarian maize exports between 1996 and 2015 with 80 partner countries. The export data come from The UN Comtrade database (UNSD, 2017), with the World Integrated Trade Solution (WITS) database and software (denominated in US dollars) (The World Bank, 2017a). The empirical analysis is based on bilateral trade of maize at the Harmonised System 4 digit level (code of HS1005).

Data for the other explanatory variables are obtained from the following data sources: Population and GDP per capita from the World Bank (2017b) database. Time variants controls include belonging to a common regional trade arrangement (RTA), belonging jointly to GATT/WTO and joint membership of the European Union. Finally, we add a time-invariant dummy (Crisis) to control the impacts of food crisis. The description and sources of variables are in Table 1.

Table 1
Description of variables

Variable	Definition	Source
XD	Dummy variable equal to unity if exports failed	World Bank (2017a)
POP	Number of population	World Bank (2017b) I
GDPCAP	GDP per capita in current US dollars	World Bank (2017b)
Distance	The physical distance between national capitals for country pairs	CEPII (2017)
RTA	Dummy variable equal to unity for country pairs that belong to the same regional trade agreement	WTO (2017)
WTO	Dummy variable equal to unity for country pairs that belong to the WTO agreement	WTO (2017)
EU	Dummy variable equal to unity for country pairs that belong to the European Union	CEPII (2017)
Crisis	Dummy variable equal to unity for period after 2007	

Source: Own compilation

Results and Discussion

In our aim to explore the duration of Hungarian maize exports, we start by performing a thorough descriptive analysis. Table 2 presents a summary of the distribution of the number of spells of service for Hungarian exports of maize over the period 1996–2015. Over this time period, there were 160 different trade relationships. Table 2 shows that half of trade relationships have a single spell of service, and other half of it has multiple spells of service, which is roughly consistent with earlier studies (Besedes and Prusa, 2006b; Peterson et al., 2017). In addition, not all of the observed 160 trade relationships were active in any given year. Beginning in 1996, there were 54 active trade relationships and declined to 37 relationships in 2015.

Table 2
Distribution spells

Total number of spells	Number of relationships	Frequency (per cent)
1	80	50.00
2	42	26.25
3	25	15.62
4	10	6.25
5	2	1.25
6	1	0.62
Total	160	100.00

Source: Own compilation

The Table 3 shows the distribution of duration length for the 160 different spells of service. Approximately 48% of all spells of service last for just a single year and approximately 72% of all spells of service last for three years or less. While short spells of service have been commonly found in the literature, most studies do not provide a detailed distribution of the number of spells by spell length except Gullstrand and Persson (2015), Besedes and Prusa (2017) and Peterson et al. (2017). In Gullstrand and Persson (2015), nearly 70% of all spells of service last just one year and 90% last three years or less. In Besedes and Prusa (2017), these frequencies are a little lower, with nearly 60% of all spells of service lasting one year and about 80% lasting less than three years. Similar indicators were around 34% and 55 % in Peterson et al. (2017). Only 9% of all spell survived in Hungarian maize exports.

Table 4 offers some initial summary statistics as to the length of Hungarian maize export flows. Table 4 shows that the median duration of a spell in our benchmark data is only 2 year. The most common scenario is, in other words, for an exporter to go from not exporting the product to a particular

Table 3
Duration of exports

Year	Number of spells	Frequency (per cent)
1	76	47.50
2	16	10.00
3	23	14.38
4	4	2.50
5	6	3.75
6	2	1.25
7	4	2.50
8	1	0.62
9	3	1.88
11	1	0.62
12	1	0.62
13	2	1.25
14	1	0.62
16	2	1.25
17	1	0.62
19	2	1.25
20	15	9.38
Total	160	100.00

Source: Own compilation

partner country to entering the market for at most 2 year, only to then leave the market again. The mean duration of exports 4,7 years is already much higher. Comparing these figures with what has been found for other countries, Hungarian maize exports appear to be similarly short-lived. For instance, Besedes and Prusa (2006a) find a corresponding median duration of 2 years for US imports at the same level of data aggregation (with a mean of over 4 years). Nitsch (2009), who uses much more detailed data, finds a median duration of 2 years for German imports, while Hess and Persson (2011) present only 1 year medians for European imports. We found much higher mean and median values for single spells and slightly higher values for first spells.

To be able to describe the trade flows with more information than a mere mean or standard deviation value will allow, we also plot a descriptive survivor function. Figure 4 depicts empirical survivor functions of wine exports spells. The x-axis plots the observed spell length, and the y-axis plots the fraction of observations whose observed spell of service ex-

Table 4
Summary statistics of spells

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
total sample	160	4.675	2	6.123	1	20
first spell	80	6.45	2.5	7.605	1	20
single spell	38	10.526	10.5	9.185	1	20

Source: Own compilation

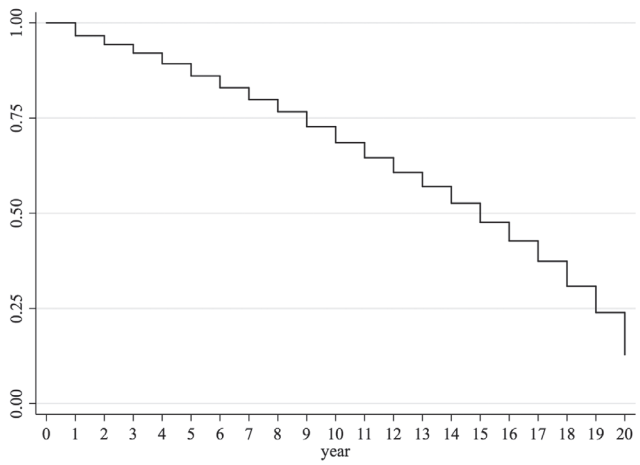

Fig. 4. Kaplan-Meier survival estimates
Source: The authors' calculations based on World Bank, 2017a

ceeds a given length. The Kaplan-Meier survival function indicate that in the first half of the period less than one third of spells have ceased, but this ratio has increased considerably in the second half of period. In other words more than 55% of all spells have ceased after economic crisis.

Now we turn to determinants of duration of Hungarian maize exports. We estimate the hazard of maize exports ceasing by estimating equation (3) using random effects probit, logit and complementary logit models, which allows us to take into account unobserved heterogeneity. As can be seen from the values of the log-likelihood functions reported at the bottom of Table 5, they are very similar across all three estimators. Table 5 shows that the size of populations for importer sides decreases the probability of maize export ceasing.

Table 5
Estimations for the full sample

	Probit	Logit	Cloglog
$lnPOP_i$	10.550	17.541	8.399
$lnPOP_k$	-0.230***	-0.442***	-0.226***
$lnGDPCAP_i$	0.861***	1.557***	0.895***
$lnGDPCAP_k$	-0.157**	-0.268**	-0.181**
lnDistance	1.035***	1.876***	1.161***
WTO	-0.196	-0.406	-0.169
RTA	0.021	0.078	-0.007
EU	-0.749***	-1.301***	-0.876***
Crisis	0.293*	0.593**	0.317*
constant	-38.200**	-65.650**	-34.930*
N	1581	1581	1581
rho	0.362	0.348	0.344
log-likehood	-644.474	-642.354	-663.591

Source: Own compilation

However, the coefficients of population are not significant implying the absence of home bias effect. Estimations suggest that the size of GDP per capita income in exporting county increase, whilst the GDP per capita on importer sides decreased the probability of maize exports failures. Similarly to earlier studies (Brenton et al., 2009; Hess and Persson 2011, 2012; Besedeš et al., 2016) estimations suggest that the distance increases the likelihood of failure in the maize export relationships in all specifications. Market access variables including joint WTO or RTA memberships have not influenced significantly the duration of maize exports. However, the EU membership strongly reduced the hazard that a given trade relationship dies. Finally, the crisis increased the probability of exports failures. Notice, that results are fairly robust to alternative estimators, although the size of coefficients are varying across different model specifications.

As reported in Table 5, there are few qualitative differences between the results from the probit, logit, and complementary logit estimations, which is an important first robustness test. We now perform further robustness checks. Following the same procedure as in the descriptive analysis above, we sequentially change the definition of a spell and use first spells and single spells. As shown in Table 6 and 7, while the two modifications strongly reduce the number of observations, the results are largely unaffected. The only exceptions are for first spell: the crisis no longer being significant anymore. When using single spells; and the level of economic development in exporting country and crisis is becoming insignificant.

Table 6
Estimations for the first spell

	Probit	Logit	Cloglog
$lnPOP_i$	3.962	0.446	2.231
$lnPOP_k$	-0.227***	-0.464***	-0.224***
$lnGDPCAP_i$	1.342***	2.406***	1.331***
$lnGDPCAP_k$	-0.194**	-0.349**	-0.252**
lnDistance	1.147***	2.200***	1.257***
WTO	-0.226	-0.498	-0.114
RTA	0.123	0.381	0.129
EU	-0.706***	-1.349***	-0.545**
Crisis	0.117	0.247	0.199
constant	-27.370	-34.591	-24.411
N	1350	1350	1350
rho	0.465	0.461	0.437
log-likehood	-421.424	-414.324	-443.328

Source: Own compilation

Table 7
Estimations for the single spells

	Probit	Logit	Cloglog
$lnPOP_i$	17.355	34.166	13.898
$lnPOP_k$	-0.302***	-0.588***	-0.356**
$lnGDPCAP_i$	0.633	1.297	0.743*
$lnGDPCAP_k$	-0.311**	-0.574**	-0.484**
lnDistance	1.314***	2.480***	1.606***
WTO	-0.005	-0.067	0.054
RTA	-0.274	-0.410	-0.245
EU	-1.070**	-1.968**	-1.351**
Crisis	-0.308	-0.494	-0.250
constant	-52.382	-103.115	-47.072
N	744	744	744
rho	0.472	0.475	0.527
log-likehood	-153.151	-151.088	-164.204

Source: Own compilation

Conclusions

The paper investigates the duration of Hungarian maize exports over the period 1996-2015. We employ different discrete time models to explain the drivers of duration in Hungarian maize exports at the world market. Hungarian maize exports have increased considerably after 2004 with strong fluctuation. The geographical concentration of Hungarian maize exports also has grown after EU enlargement with considerably yearly variation in terms of trading partners.

Some interesting empirical findings emerge in our analysis. First, in line with the literature on the trade duration we find that Hungarian maize exports to the world are indeed very short-lived. The median duration of Hungarian exports is merely 2 year. Moreover, almost 48% of all spells cease during the first year of service, while approximately 72% of all exports flows terminate within the first 3 years.

Second, in the regression analysis we identify several determinants of trade durations, and because of the improvements in econometric method compared with earlier papers, we can more confidently assess not only their statistical but also their economic significance. In particular, we show that the standard ‘‘gravity’’ determinants of trade including market size, level of development and trade costs do not only affect export values but also export duration. From the market access variables only the EU membership has significant impacts on the Hungarian exports durations. Finally, economic crisis decrease the probability of failure of maize exports for full sample, whilst this effect is not significant in subsamples.

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